

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
14 March 2002 (14.03.2002)

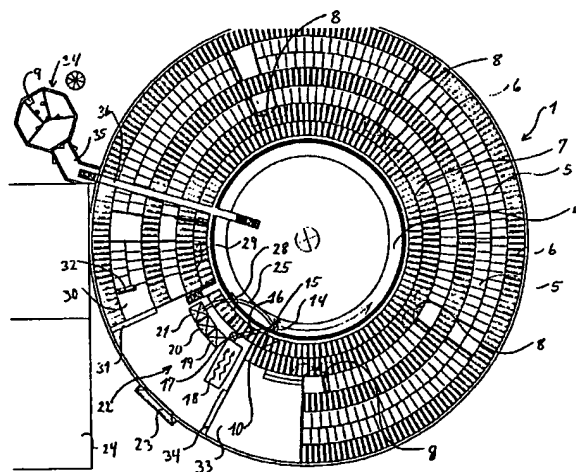
PCT

(10) International Publication Number  
WO 02/19807 A1

- (51) International Patent Classification<sup>7</sup>: A01K 5/02 (74) Agent: PATRADE A/S; Fredens Torv 3A, DK-8000 Aarhus C (DK).  
// 1/12, A01J 5/007
- (21) International Application Number: PCT/DK01/00581 (81) Designated States (*national*): AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EC, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (22) International Filing Date: 4 September 2001 (04.09.2001) (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- (25) Filing Language: Danish
- (26) Publication Language: English
- (30) Priority Data: PA 2000 01313 4 September 2000 (04.09.2000) DK
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- Published:  
— with international search report

[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR INDIVIDUAL FEEDING OF ANIMALS



(57) Abstract: A system and a method for feeding animals (2), each comprising an information carrier (3), is described. The system is used for determining the individual need for feed and for establishing individual amount of feed on the basis of registering of data on the carrier (3) by using a central control unit (9). Thus there is provided a feed station (22) comprising at least one feed hopper (19-21) and dosing means (17) controlled by the central control unit (9), and which comprises discharge means (15) discharging in a feed/drinking trough (14). In order to save construction costs and to ensure that the animal (2) is only eating when needed, the drinking trough (14) is provided in a carousel (4) with a number of feeding spaces. The animals' (2) access occurs via one or more selection gates (8) between the resting area and a concentration area (7) around the carousel. The selection gates are opened on the basis of data on the carrier (3) if the animal (2) is allowed to consume feed.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## SYSTEM AND METHOD FOR INDIVIDUAL FEEDING OF ANIMALS

**Background of the Invention**

5 The present invention concerns a system for individual feeding of animals that each are provided with an information carrier containing data used for determining the need for feed of each single animal, a central control unit for registering data on the carrier and processing these for determining the actual amount and mixture of feed that the animal is needing, a feed station connected with the control unit and comprising at least one feed hopper and discharge means discharging into an eating-drinking trough  
10 which is provided in a carrousel having a number of feed spaces with each their trough, and that the animals' access to the carrousel occurs via a gate comprising registering means registering data on the carrier and transmitting these to the control unit.

15 The invention furthermore concerns a method for individual feeding of animals that each are provided with an information carrier containing data which are used for determining the need for feed of each single animal as a central control unit is used for registering data on the carrier and processing these for determining the actual amount and mixture of feed that the animals is in need of, where the control unit gives off a signal to a feed station comprising at least one feed hopper and discharge means discharging into an eating-drinking trough at which the feeding is performed in an eating-drinking trough rotated in a carrousel with a number of feeding spaces where the animals are staying during the feeding, and that the animals' access to the carrousel is controlled via a gate.

25 Still more high-technological systems are used in modern farming for increasing effectiveness by minimising costs of construction. Thus it has been more widespread to use a central control unit and information carriers for registering animals living in herds but having need for individual feeding, treatment and the like. By comparing information from the information carrier with information stored in a central control  
30 unit, it is possible to ensure individual handling in the form of feeding, milking, sorting off from the herd etc. Hereby the need for manual supervision and handling of the animals is reduced.

Feeding systems enabling individual feeding of animals living in herd are known, as information carriers, e.g. in the form of tags, transponders or similar are used. These systems comprise a number of eating-drinking troughs located in an area of the stable where the animals are going to eat. When an animal is seeking this area, it will be fed as a registration is performed when it is standing at the eating trough. As a result of this registration, the control unit will activate the feeding system and provide for the amount of feed needed to be supplied to the trough. This occurs irrespectively whether there is need for a greater or lesser amount of feed. Animals, which are pleasure eaters, may come often and get smaller amounts of feed. This results in a great load on the capacity of the system. When the animal is finished with eating, it will go back to the resting area of the stable. Thus there is no possibility of sorting off/redirecting an animal for special handling, e.g. due to sickness, pregnancy or other. This occurs by manual supervision and handling.

Systems comprising gates with antennae for registering animals passing through the gate, e.g. to a milking facility, are also known. These systems are registering which animals are passing and enables adaptation of a subsequent process, e.g. milking, to the individual animal.

It is the purpose of the invention to indicate a new system and a method of the kind mentioned in the introduction where the data carrier may not only be used for establishing the individual need for feed of the animal with a technically simple and economically advantageous feeding system, but which also enables that only the animals having a real need for feed will get access to the feeding area, and which enables reduction in the manual handling of the animals when these are to be sorted off the herd of one or the other ground.

According to the present invention, this is achieved with a system of kind mentioned in the introduction being peculiar in that the carrier is provided with data about the feed need of the animal, that second registering means are provided at the exit of the carrousel for updating and registering data on the carrier, that third registering means are provided on the trough for registering remaining feed in the trough when the animal leaves the carrousel, that the control unit is arranged for processing data from the

registering means for registering the real need for feed of the animal, and which opens the gate when the animal has accumulated sufficient need for feed and thereby is accepted after processing the signal from the carrier.

- 5 The method according to the invention is peculiar in that the data of the information carrier are updated at the exiting of the animal after each visit in the carrousel, at least with information about the time for the last feeding, that the control unit processes data from the registrations, that the real need for feed of the animal is registered, and that the gate is opened if it is registered that the animal has accumulated sufficient  
10 need for feed and is then accepted after registering and processing data on the carrier.

The applied trough may be used as a combined eating and drinking trough, or as eating trough only.

- 15 As the information carrier contains updated information from each visit in the feeding carrousel, the control unit may be provided with a program which is not opening the gate or gates to the feeding carrousel if the animal is returning too quickly. The data stored may thus also contain information about the time of the latest feeding(s), and hereby there may be registered a time interval before the next accepted time for feed-  
20 ing. Hereby, loading the capacity of the feeding system with animals, which only could be allocated a small amount of feed because they are coming with short interval, is avoided.

- When the exit of the carrousel is connected with weighing means, it is possible to  
25 register the weight of the animals. Other registration means are also provided at or in association with the exit, so that it is possible to register data concerning yielded amount and quality of milk, and to register the amount of remaining feed when the animal leaves the feeding space. These measurements are used for providing information about the eating desire and health condition of each single animal.

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It is possible to use different kinds of information carriers. However, it is preferred to use transponders. These may be active and may e.g. be arranged for emitting a

sound/vibration signal which indicates to the animal that it is now being accepted for feeding.

5 Around the carrousel there is built a round stable. The feeding system is arranged for continual apportioning of whole feed round the clock. Thus it will be possible for the animals to eat at the time of the day when they want.

10 As there is no need for expensive feed tables in the stable, but where the carrousel is provided instead, where feeding occurs in simple troughs by means of a simple feeding system, not only a technically simple but also cheap feeding system is achieved.

15 If it is a system where dairy animals are fed, it will be possible for the animals to take feed when they are milked or at other times. Milking will normally be performed twice a day, and in practice the animals will consume a smaller amount of feed during the milking. Thus other animals in the herd which are milked, may also be accepted for feeding allocation at other times than the times at which the milking is performed. In the control unit it will be possible to put in priority so that dairy animals are preferred within a certain time interval in relation to other animals in the herd which are not to be milked.

20 The use of gates in the form of so-called selective gates when entering a concentration area at the entrance to the carrousel enables rejective selection of animals for feeding. The selective gates thus allow the animals to come into the concentration area around the carrousel, and by entering the carrousel itself, a sensor/antenna is used for registering the individual animal for determining the actual amount or composition of feed.

25 At the exit of the carrousel there is provided a separating gate registering the actual animal, either giving access to the resting area for the animal or to a separation area in accordance with a signal from the central control unit. Thus it will be possible to sort off cows registered as having too large cell count in the milk. Such a registration may be performed by registering the yielded milk from previous milkings. Other conditions may be registration of bad health condition due to lack of desire to eat.

It will furthermore be possible to sort off animals having too high or reduced activity. This may be registered by the central control unit via the data carrier. Such a change in activity may e.g. be caused by heat/rut or sickness.

- 5 By registration it is also possible to sort off animals having fever. This may e.g. be measured by the temperature of the milk.

It is possible to perform the sorting off by the animals not being allowed to the resting area around the carrousel. The sorting off occurs by making the gate so that the animals are directed into the separation area for separate handling and treatment.

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With the system and the method according to the invention it is thus possible not only to perform registering and control of the individual need of feed of the animal and control of the individual types of feed in a ration. It is also possible, via the control of the gate, to control the animals' access to the feeding area. Registration may simultaneously be used for sorting off from a herd so that the need for manual supervision and handling of the animals is reduced to a considerable extent. The farmer only needs to focus on the animals requiring separate handling, and which are not allowed access to the resting area, and which are redirected to a separate stable area.

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The control system may also be used for registering lack of activity in the case of no animals going into the feeding area. Such a registering may possibly be shown on a display or by a print in the shape of a separate report. In such a situation, the user does not need to be present in the stable in order to register the animals which have not gone to or have been denied access to the feeding area and/or the carrousel.

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It is preferred to arrange the system with an concentration area outside the carrousel where the animals are passing through the selective gates from a surrounding resting area. Thus the animals may be able to pass through the gates between the resting area and the concentration area outside the carrousel itself. Alternatively, the access to the carrousel may occur by a selection gate situated at the entrance to the carrousel, ensuring individual feeding when the animal occupies a feed space in the carrousel. By constructing the system with a concentration area, however, waiting time may be

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avoided as the animals will be placed in immediate association with the entrance to the carousel.

5 The system will preferably be arranged with an emptying device that empties and registers the feed left in the eating-drinking trough. Hereby, not only information about the feed consumption of each single animal is ensured, but also a good feed hygiene in the stable without any need of manual cleaning.

10 As the feeding takes place in a carousel containing an eating-drinking trough, only a single dosing unit will be required, thus reducing construction costs. This dosing unit is situated at a suitable location in the stable together with the feed hopper giving off the individually determined amount of feed to the dosing unit. The dosing unit is connected with a conveyor which may be of different kind, and which at its other end is provided with a discharge means ensuring that the feed is filled into the trough.

15 The discharge means may be screw conveyors, funnels or similar. The conveyor is preferably a conveyor belt. This may be arranged pivotably for being pivoted in over a trough in the carousel or, alternatively, a conveyor may be mounted fixed at a level above the carousel so that this may freely turn under the carousel. In this situation, in  
20 the carousel there may be provided a filling tube or similarly discharging in proximity of the discharging means of the conveyor with purpose of reducing distance in the free fall of the feed and thereby reducing the risk of waste.

25 With the system and the method according to the invention, it is possible to reduce the manual handling of the animals. Thus it is not necessary to partition and move around with the animals. These may stay in the same stable system. For cows, it will thus be possible to keep all the animals in the same herd except for the time of calving. In large herds where cows have to walk a long distance in order to reach a feeding table and for milking, it is advantageous with the round construction with a carousel situated centrally in the stable. Thus it will be possible to reduce traffic and handling of  
30 cows as well as feed, since everything occurs centrally.



With the system according to the invention, the central feeding control with one feeding facility for all the animals and with individual possibility for feeding and composition of feed will mean that each single animal can be offered completely fresh untouched feed both day and night. Since the animals are only accepted for access for feed when a certain time has elapsed since the last feeding, the animals will eat the entire amount of feed discharged. The risk that the animals are only consuming the tasty and leaving the remaining part for subsequently going back into the facility again when hunger appears is thus avoided. Thus it is ensured that the animals receives the desired nutrient composition. On the basis of the central control it will be possible to perform a changing of the feed in the course of the day.

By the registration, measurement of the weight, yield, activity, sickness, etc. may thus be performed. This forms a basis for the composition of individual feed ration for each single animal. Thus the number of feed dependent sicknesses may be reduced. The feeding system may create balance between the need of the animal and the composition of the of the allocated feed. This also means that the feeding system may easily be used for feeding experiments as results in the form of yield, weight, activity may be registered quickly. Furthermore, such experiments may be performed with a number of animals without involving other animals in a herd.

The system according to the invention will be placed in a round stable giving a supplementary advantage in the form of natural ventilation. When the stable is built up with a pointed roof, a good natural ventilation may be achieved due to very great driving height. Thus, ventilation located at the top will result in a strong effect. It will be possible to place gill plates in the stable wall for controlling the wind from an actual wind direction which is not possible with prior art stable designs. Manual work with adjusting the ventilation system may thus be reduced simultaneously with optimising air renewal. Hereby an improved climate is achieved as the improved ventilation has to imply less condensation. Due to a central air vent at the centre of the stable, large air renewal will occur without any substantial draught arising therefrom.

A round building will furthermore be more stable and resistant to storm than a four-sided. Also, an extension may easily be provided by building a further "ring" containing further resting spaces.

## 5      **Description of the Drawing**

The invention will explained in more details with reference to the accompanying drawing, where:

- Fig. 1    shows a plan view of a stable with a system according to the invention,  
10    Fig. 2    shows a side view of the stable shown in Fig. 1, and  
Fig. 3    shows a schematic diagram of elements forming part of the system according to the invention.

15    In the different Figures of the drawing, identical or corresponding elements are designated with the same reference numeral. An explanation is given with simultaneous reference to the different Figures in the drawing, which, as a non-limiting example, illustrate the system for application in a cow-house 1, where cows 2 are provided with transponders 3 tied around their necks and containing data about the cow 2. The system comprises a carrousel 4 which is a milking carrousel where the cows 2 are milked  
20    simultaneously with being fed.

Around the round carrousel 4 there is constructed a round stable 1 consisting of rings of bed boxes 5 and slatted floors 6. In the inner ring, a concentration area 7 is provided to which the animals get access through gates 8. The gates 8 are controlled by a central  
25    control unit 9. With the system, it is thus possible to get the cows into the concentration area 7. Via an entrance 10, they may therefrom be led into the carrousel as there is provided a gate (not shown) also here.

30    When the milking carrousel 4 is started, automatic drivers may be used which are not described any further since they are well-known. Such drivers will ensure that the cows are automatically sent to the starting point of the carrousel as soon as they have entered the accumulation area 7 around the carrousel 4. Such drivers will only be used in connection with the times during which milking is performed.

In the gates 8 antennae 11 are provided, performing registration of data in the transponder 3. As a consequence of this registration, a signal 12 is transmitted to the control unit after which a signal 13 is returned to the gate, either opening the gate or keeping the gate closed if the animal is denied access through the gate.

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When the animal has come into the carrousel, there will occur a feed allocation as an eating-/drinking trough 14 is provided at each space in the carrousel. Above the eating-/drinking trough there are provided discharge means 15 connected with a conveyor belt 16 advancing feed from a dosing unit 17. The dosing unit 17 is provided outside  
10 the carrousel and is part of a feed system which furthermore comprises a whole feed mixer, a distributing table 18 and a number of feed hoppers 19,20,21 for different kinds of feed. It is possible to use more feed hoppers than those shown, and it will be possible to use different kinds of feed, e.g. turnips, concentrated feed, etc.

15 It will be easy to get access via a gate 23 to the centrally situated feed system which in general is designated with 22. All supply for feeding all the animals takes places via the feed system 22, reducing handling and transport of feed. The feed may be transferred directly from a near storage building 24, either by machines, truck or via conveyors from silos or similar storage compartments.

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The feed system 22 may be provided with several conveyors leading into the discharging means 15. Thus a screw conveyor 25 may also be provided, connecting one of the feed hoppers 21 directly with the discharge means 15. The conveyors 16,25 may be disposed pivotably so that they may be swung outside the path of the carrousel or  
25 alternatively, they may be disposed at such a height that the carrousel may freely rotate under the conveyors.

The dosing unit 17 is connected with the central control unit 9, and when a cow 2 is registered, a control signal 26 is transmitted to the dosing unit, which consequently  
30 composes the correct individual amount of feed for the animal in question. A control signal 27 is transmitted back to the control unit as an indication that the amount of feed is allocated.

When the animals have been through one revolution of the carrousel 4, this is left via an exit 28 with a separation gate 29. Hereby the animals are led directly back to the resting area or to selective rejection. If animals are to be rejected selectively due to heating/rutting, calving, sickness or the like, this may occur by the animals, via the separation gate 29, being led to a separation area 30 where manual handling may be performed. In this way there may be provided a separate feed table 31 and separate water vessels 32.

In the stable 1 shown, there is furthermore provided an area 33 used for calving. Here is also provided a separate feed table 34. The separate feed tables 31,34 are suitably provided in immediate proximity of the feed system 22 so that feeding may be performed easily. This may possibly occur by the conveyor 16 being pivoted in over the feed tables 31,34.

Associated with the carrousel there is provided a weighing unit 41 which registers the amount of remaining feed, properties of the milk in the form of temperature, cell count etc. Weighing may occur by the trough having self-emptying bottom which at a particular position is released by a finger so that remaining feed falls down on weigh belt under the carrousel. The milk is preferably registered during milking so that the result is registered and processed when milking is finished. As a result of these measurements, a signal 43 is transmitted to the central control unit 9, and the central control unit may possibly transmit a return signal 42 as indication of correct reception. These data may be used for controlling the general health condition of the animal, cf. previous description, and for controlling the separation gate 29.

At the exit 28 there is provided a scale 44 weighing the cow. As a result of this weighing, a signal 45 is transmitted to the central control unit. A signal 46 may be returned as documentation of correct reception. Furthermore, such a return signal may simultaneously be used for controlling opening and closing the separation gate 29 for directing a cow to the separation area 30 if this appears to be necessary.

In the construction shown, 34 designates a technicians' room located in association with the stable 1, and where a number of technical functions are situated, including the

central control unit 9. The separate building is, via a footwalk 35, connected to the stable, and inside the stable there is a gangway 36 extending across the whole resting area. As the stable is constructed as a round stable with an upwardly tapering roof 37 as shown in Fig. 2, the farmer will have a good overview over the whole stable from the gangway 36. At the same time, the gangway 36 serves as access route to the carrousel 4. Furthermore, a circular gangway may be disposed over the carrousel. Also, a glass housing may be provided over the carrousel in order to get an overview over the entire stable.

The stable building will, due to its great height, establish a good natural ventilation. Vents 38 situated centrally at the top of the building will thus provide good ventilation via an upwardly directed air flow coming in via gills 39 located in the wall 40. The gills 39 may be arranged opening with regard to the wind direction for avoiding draught in the stable.

In the construction shown, four selection gates 8 are provided, used for through passage of the animals from the resting area 5 to the concentration area 7. At these gates it is checked whether a cow 2 has just eaten. If this is the case, the cow will not be accepted and will therefore not get access to the concentration area 7 and thereby to the carrousel 4. This will only be the case outside milking hours.

The central control unit may be programmed so that a cow which has just eaten, will be allowed access at the time of the start of the milking carrousel. However, due to the selective access only allowed for at certain time intervals, the cows will be accustomed to going into the concentration area 7 for feeding and/or milking at suitable times.

With the supervising system it is thus ensured that feed is consumed at regular time intervals whereby the rumen function (the pH of the rumen) of the cows is kept in order. Thus there will be no need for any manual handling to ensure the regular feeding of the animals. This occurs automatically via the control in the central control unit 9 in combination with data registered on the transponders 3 on each single cow 2.

## CLAIMS

1. A system for individual feeding of animals that each are provided with an information carrier containing data used for determining the need for feed of each single animal, a central control unit for registering data on the carrier and processing these for determining the actual amount and mixture of feed that the animal is needing, a feed station connected with the control unit and comprising at least one feed hopper and discharge means discharging into an eating-drinking trough which is provided in a carrousel having a number of feed spaces with each their trough, and that the animals' access to the carrousel occurs via a gate comprising registering means registering data on the carrier and transmitting these to the control unit, characterised in that the carrier is provided with data about the feed need of the animal, that second registering means are provided at the exit of the carrousel for updating and registering data on the carrier, that third registering means are provided on the trough for registering remaining feed in the trough when the animal leaves the carrousel, that the control unit is arranged for processing data from the registering means for registering the real need for feed of the animal, and which opens the gate when the animal has accumulated sufficient need for feed and thereby is accepted after processing the signal from the carrier.
2. A system according to claim 1 for feeding dairy animals such as goats or cows, characterised in that the carrousel is a milking carrousel as the animals are milked while they are fed.
3. A system according to claim 1 or 2, characterised in that second registering means at the exit from the carrousel registers data concerning yielded amount and quality of milk.
4. A system according to any preceding claim, characterised in that the feeding station comprises a dosing unit connected with the feed hoppers, and which discharges the individually determined amount of feed at one end of a conveyor which at

its other end has discharge means in the form of funnel or similar filling the feed into the trough.

5 5. A system according to claim 4, characterised in that the conveyor is a pivotable conveyor belt arranged to be able to pivot in over a trough in the carousel.

6. A system according to claim 4, characterised in that the conveyor is arranged at a height over the carousel so that this may turn freely under the conveyor.

10 7. A system according to any preceding claim, characterised in that that the third registering means in the carousel for registering remaining feed in the eating-drinking trough when the animal leaves this comprises a weighing unit.

15 8. A system according to any preceding claim, characterised in that the information carrier is a transponder.

9. A method for individual feeding of animals that each are provided with an information carrier containing data which are used for determining the need for feed of each single animal as a central control unit is used for registering data on the carrier and  
20 processing these for determining the actual amount and mixture of feed that the animals is in need of, where the control unit gives off a signal to a feed station comprising at least one feed hopper and discharge means discharging into an eating-drinking trough at which the feeding is performed in an eating-drinking trough rotated in a carousel with a number of feeding spaces where the animals are staying during the  
25 feeding, and that the animals' access to the carousel is controlled via a gate, characterised in that the data of the information carrier are updated at the exiting of the animal after each visit in the carousel, at least with information about the time for the last feeding, that possible remaining amount of feed is registered when the animal has left the feeding space, that data on the carrier are registered, that the control  
30 unit processes data from the registrations for determining the real need for feed of the animal, and that the gate is opened if it is registered that the animal has accumulated sufficient need for feed and is then accepted after registering and processing data on the carrier.

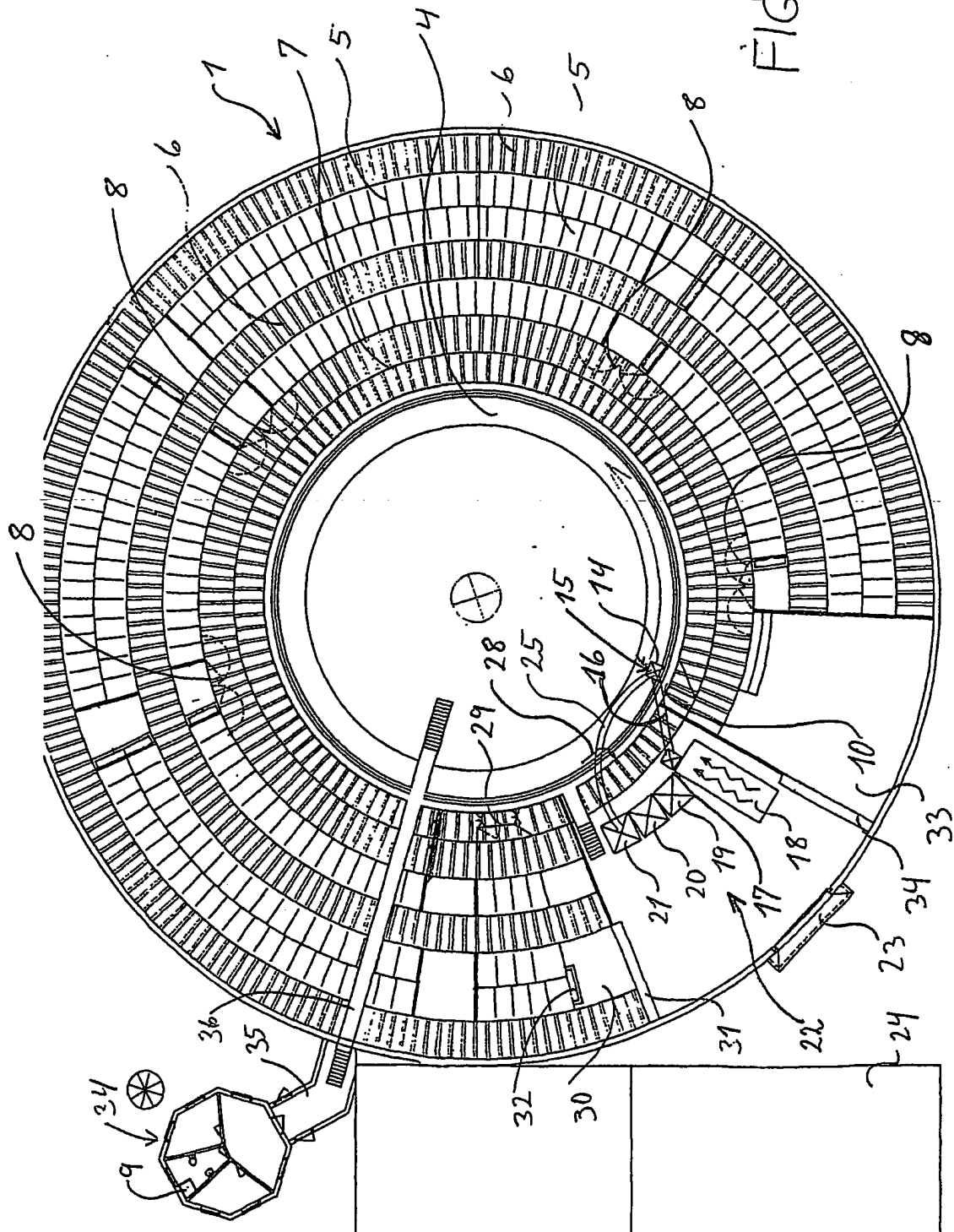
10. A method according to claim 9, characterised in that the animals are milked simultaneously with their feeding.

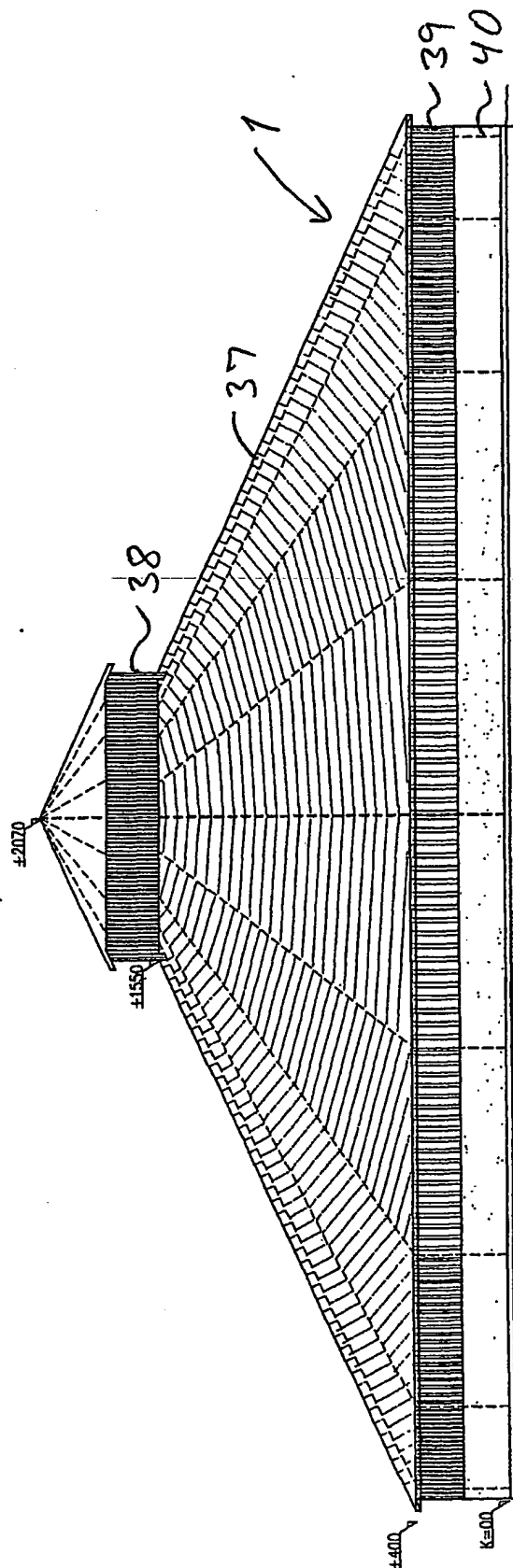
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FIG. 1





11/6/2

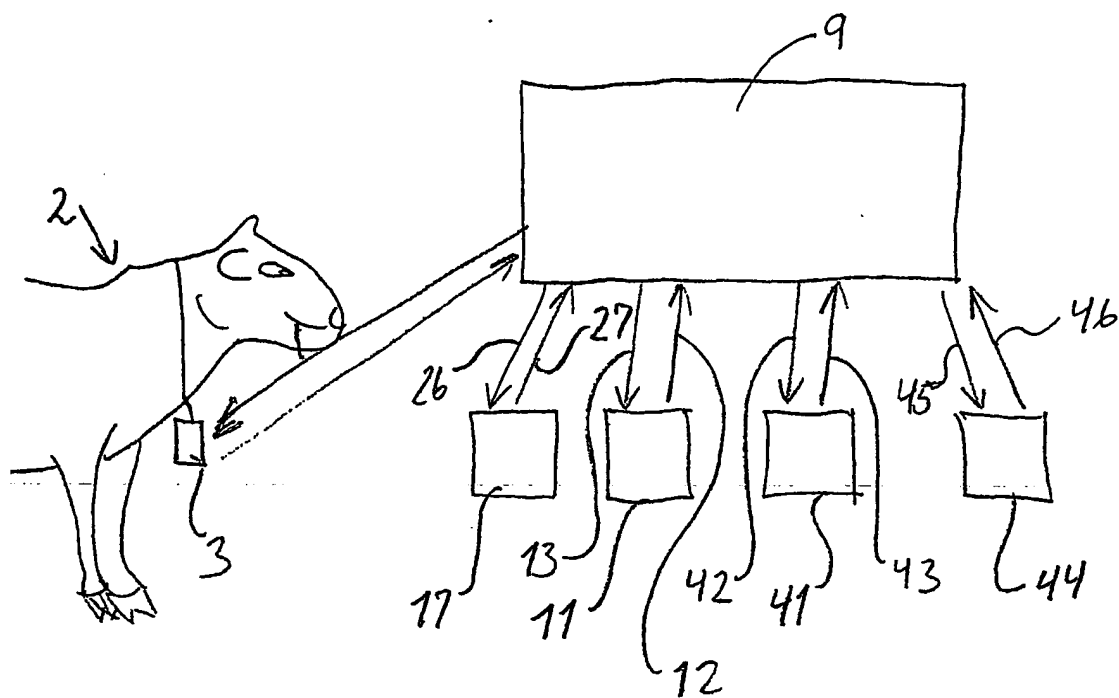


FIG.3

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 01/00581

## A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A01K 5/02 // A01K 1/12, A01J 5/007

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A01K, A01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5778820 A (VAN DER LELY ET AL.), 14 July 1998 (14.07.98), column 5, line 44 - column 6, line 29 --	1-4,7-10
A	FR 2757742 A1 (GABARD MICHEL), 3 July 1998 (03.07.98), page 5, line 9 - line 25; page 6, line 18 - line 22 --	1-4,9,10
A	GB 1240108 A (GASCOIGNES (RESEARCH & DEVELOPMENT) LIMITED), 21 July 1971 (21.07.71), page 1, line 19 - line 43 --	1-4,9,10
A	EP 0091892 A2 (ALFA-LAVAL AB), 19 October 1983 (19.10.83), page 7, line 29 - line 32 --	1-3,9,10

☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

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"&amp;" document member of the same patent family

Date of the actual completion of the international search

19 November 2001

Date of mailing of the international search report

03 -12- 2001

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/DK 01/00581

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